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ABSTRACT

Parsing sentences into meaningful phrases and clauses is an essential step in language comprehension, and parsing difficulty is a common reading problem. Prosody (intonation, stress, and rhythm) provides information about phrase and clause boundaries in spoken language that is not available in written language. In an experiment to test whether prosodic information facilitated children's parsing of sentences, 20 above and 20 below average readers in the fourth grade divided sentences into meaningful word groups. There were two presentation conditions: a no-prosody condition in which the sentences were presented in written form only, and a prosody condition in which they were presented in both written and spoken form. The results suggested that below average readers have difficulty parsing sentences when prosodic information is not available, but are able to parse sentences about as well as the above average readers when prosody is available. (Author)

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Technical Report No. 123

PROSODY AND CHILDREN'S PARSING OF SENTENCES

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Abstract

Parsing sentences into meaningful phrases and clauses is an essential step in language comprehension, and parsing difficulty is a common reading problem. Prosody (intonation, stress, and rhythm) provides information about phrase and clause boundaries in spoken language which is not available in written language. This experiment tested whether prosodic information facilitates children's parsing of sentences. Above and below average readers in the fourth grade divided sentences into meaningful word groups. There were two presentation conditions. In the no-prosody condition, the sentences were presented in written form only, while in the prosody condition they were presented in both written and spoken form. The results suggest that below average readers have difficulty parsing sentences when prosodic information is not available, but are able to parse sentences about as well as the above average readers when prosody is available.

Prosody and Children's Parsing of Sentences

Parsing sentences into meaningful phrases and clauses is an essential step in language comprehension. According to current models (e.g., Clark & Clark, 1977; Kleiman, 1975), language comprehension involves a limited capacity working memory which holds surface representations of input words. Various processes operate upon the words in working memory to parse them into constituents (phrases and clauses) and to determine the meanings expressed. Once the meaning of a constituent has been determined, the individual words no longer need to be held in working memory, thereby freeing some of its capacity for new input. If one fails to parse sentences appropriately, comprehension will be impaired. In fact, there is evidence that parsing difficulty is often an aspect of reading comprehension failure. A common reading problem is that of reading "word-by-word," rather than chunking the words into meaningful phrases and clauses (Clay & Imlach, 1971; Golinkoff, 1975-76).

In the comprehension of both written and spoken language, syntactic and semantic information can be used to parse sentences into constituents (see Clark & Clark, 1977, chapter 2). The two modalities differ in that speech contains prosodic information (intonation, stress, and rhythm) which can be useful in sentence parsing, while print does not. Written language can be understood without prosody because prosodic information is generally redundant with syntactic and semantic information, or is replaced by punctuation. Although language without prosody can be comprehended, the

redundancy it provides may facilitate comprehension, and the lack of prosody in written language may contribute to difficulties in reading comprehension. In this paper, we will first review some of the evidence that prosody can be useful in parsing. Then we will report an experiment which tests whether prosodic information facilitates children's parsing of sentences.

Several types of prosodic cues to phrase and clause boundaries have been identified in acoustical studies. Cooper and Sorenson (1977) found evidence that these boundaries tend to be marked by a specific pattern of pitch change. Klatt (1976) and Sorenson, Cooper, and Paccia (1978) found that phrases are marked by an increase in the duration of their final syllables. Scholes (1971) argued that the relative peaks in loudness provide the most reliable cues to syntactic boundaries. In addition, pauses in speech provide information of potential use in parsing (Grosjean, Grosjean, & Lane, 1979). These studies suggest that pitch, duration, loudness, and pauses can all provide useful information. Which dimension predominates may vary according to the speaker and the structure of the sentence.

The usefulness of prosodic cues in parsing is most apparent in cases of surface structure ambiguity. For example, the sentence I fed her dog biscuits has two possible readings, either she was fed dog biscuits or her dog was fed biscuits. In speech, these two readings would be reflected in different prosodic patterns which would enable the listener to determine whether the appropriate parsing is I fed her / dog biscuits or I fed / her dog / biscuits. Lehiste (1973) provides evidence that listeners can use prosodic information to determine the intended meanings of such sentences.

Prosodic cues to sentence structure are also available in sentences that are not ambiguous. In a study by Scholes (1971), pairs of words were used which, when placed in different contexts, either were within the same clause or had a clause boundary between them. For example, the word pair spotted plant appeared in the following two sentences:

If you find your flowers spotted plant them in the sun

If you find your spotted plant let me know

Tape recordings were made of 10 speakers reading each of the sentences aloud. The word pairs were then excised from the sentences and played to subjects who were asked to judge which sentence each word pair was in when it had been recorded. Subjects did significantly better than chance.

Several other studies have provided evidence for the use of prosody in sentence parsing by creating sentences in which there is a mismatch between prosodic and syntactic information. This was done by using sentence pairs that have a string of words in common, but different constituent boundaries within the string, as in the example given above. Both sentences were recorded with normal intonation and then the common word string was spliced from one context to the other. These studies have yielded two main results. One is that subjects' recall errors generally consisted of changes in wording such that the syntactic structure of the reported sentence fit the prosodic pattern that was actually presented (Darwin, 1975; Wingfield, 1975; Wingfield & Klein, 1971). That is, subjects resolved the discrepancies between intonation and syntax by altering the syntactic structures of the sentences. This may be related to Garnes and Bond's (1975) finding that

misperceptions of natural speech occur on phonemes, syllables, words, and phrases, but that stress and intonation patterns are rarely misperceived.

The other result is based on the finding that, with normal spoken sentences, subjects tend to accurately report the location of interrupting stimuli (such as clicks) when they occur at syntactic boundaries, but inaccurately report them when they occur within syntactic units (Fodor & Bever, 1965). In sentences in which syntax and prosody mismatched, interrupting stimuli that occurred at the boundary marked by prosody were reported most accurately (Wingfield & Klein, 1971; see also Geers, 1978), Additional support for the claim that prosody plays a role in sentence parsing can be found in Svensson (1974).

The experiment to be reported tested whether children parse sentences more appropriately when prosodic information is available than when it is not. This hypothesis was tested with both above average and below average readers in the fourth grade. The children were asked to divide sentences into meaningful groups of words. There were two presentation conditions. In the no-prosody condition, the sentences were presented in written form only, and the children indicated word groups by marking slashes in the places they judged appropriate. In the prosody condition, the children were given both written and spoken forms of the sentences and marked word groups as in the other condition.

Method

Subjects

Twenty above average and 20 below average readers from fourth grade classes in several central Illinois schools participated in the experiment. At fourth grade most of the children can decode individual words but "word-by-word" reading is still a commonly reported problem (Kennedy, 1977). The Stanford Diagnostic Test had been administered by the schools, and the assignment of children to above or below average reading groups was based on the national percentile scores on the reading comprehension subtest. The above average group had a mean national percentile score of 77.9 (standard deviation = 11.8), and the below average group had a mean score of 29.8 (standard deviation = 15.4). There were 13 boys and 7 girls in the above average group, and 11 boys and 9 girls in the below average group. In order to determine where adults would mark word group boundaries in the sentences used in this study, 20 community college students also served as subjects.

Procedure and Design

The children were instructed to divide sentences into meaningful groups of words and were shown how several example sentences might be divided. In the no-prosody condition, the sentences were presented in writing only, with each sentence on its own page. The children were instructed to read each sentence twice, thinking about which words formed meaningful groups on the first reading and marking slashes at the word group boundaries on the second reading. In the prosody condition, the children heard each sentence read aloud twice and also received a written presentation identical to that in

the no-prosody condition. The spoken versions were tape recorded by a professional speaker naive as to the purpose of the experiment. The children were instructed to just listen and think about word groups on the first spoken presentation, and to read along and mark the boundaries on the second presentation.

The stimuli consisted of four descriptive passages about creatures on a fictional planet (see appendix for a sample passage). In these passages, which were written by the experimenters, the vocabulary was kept as simple as possible. The children were asked to circle words they had trouble reading during the experiment, and none of the children circled any words. The passages were grouped into two pairs, each pair containing a total of 48 sentences. Each child received one of the passage pairs in the prosody condition and the other in the no-prosody condition. These two conditions were run approximately one week apart, with order of condition and order of passage within condition counterbalanced across subjects. The experiment was run with groups of children mixed as to reading ability.

Analysis of the children's data required determining where word group boundaries should be marked in the sentences. In order to facilitate doing so, we chose to focus on five types of structures. All of these structures occur frequently in fourth grade reading materials and the four passages included many examples of each. The five types of structures considered in this study are:

(A) Clause subordination marked by the first word of the sentence (e.g., Because they have such long wings they can fly very fast). The initial words used in these sentences were because, when, and if.

(B) Clause subordination marked by a word in the middle of the sentence (e.g., The people on Orese get scared when they know glods are coming). Again, sentences with because, when, and if were used.

(C) Clause conjunction. This set contained three subtypes, distinguished by whether the subject of the second clause was a noun phrase (e.g., Young glods sleep under rocks and adult glods sleep in trees), a pronoun (e.g., Glods are very large and they are easy to see) or was deleted (e.g., Glods sleep during the day and eat at night).

(D) Sentence initial noun phrases. These varied in number of adjectives (e.g., young glods, the yellow winged glod, some very brave people). Some initial noun phrases contained conjunctions (e.g., many men and women), and some contained prepositional phrases (e.g., the glods with two mouths).

(E) Within-phrase conjunction. The subtypes of this category included simple noun conjunction (e.g., trees and bushes), adjective conjunction (e.g., big and old), conjunction of phrases that contain prepositional phrases (e.g., glods with one mouth and glods with two mouths), and various combinations of these (such as a single word noun phrase conjoined with a noun phrase that contained a prepositional phrase).

These five structures enabled us to determine particular positions in the sentences upon which to focus: the boundaries between clauses (either subordinated or conjoined), the ends of initial noun phrases, and the conjunctions within phrases.[1] However, appropriate places to mark word group boundaries cannot be determined by syntax alone; length of the

syntactic units is also a determining factor (see Grosjean, et al., 1979). For example, in a pilot study using the parsing task, adults rarely marked initial noun phrases that consisted of only an article and a noun. Likewise, the length of conjoined elements within phrases influenced whether they were marked as separate word groups. Therefore, in order to empirically determine the points at which boundaries between word groups should be marked, 20 adults were given the parsing task. The adults, run as a group in one session, received all four passages in written form and were given the same instructions as the children in the no-prosody condition. Those points at which at least 50% of the adults marked boundaries were considered to be points that required breaks. When this criterion was applied to the four passages, all but one of the boundaries between two clauses were counted as points requiring breaks. There were 23 required breaks between subordinated clauses marked by initial words (denoted by A in appendix), 18 required breaks between subordinated clauses marked by sentence medial words (B in appendix), and 18 required breaks between conjoined clauses (C in appendix). Only 3 of the 29 initial noun phrases containing three or fewer words required breaks according to the criterion, while 24 of 34 initial noun phrases of four or more words required breaks (D in appendix). Likewise, whether within-phrase conjunctions required breaks depended on the number of words in the conjoined elements. Twenty-one phrases with conjunctions met the criterion of requiring breaks (E). Overall, in the four passages there were 107 points requiring breaks.

Results

Each of the 20 above average readers and 20 below average readers received 48 sentences in the prosody condition (written presentation only) and 48 sentences in the no-prosody condition (both written and spoken presentation). An initial analysis was performed on the number of word groups marked, without regard as to whether the marks were at required breaks. The data, which are presented in Table 1, failed to show any statistically significant differences.

Insert Tables 1 and 2 about here

The main analysis of interest was of the frequency with which the children marked breaks at the 107 points requiring breaks. These data (see Table 2) showed that children's parsing was better in the prosody condition than in the no-prosody condition, $F(1,38) = 16.87$, $p < .001$. The above average readers did somewhat better than the below average readers, but this difference failed to reach statistical significance, $F(1,38) = 2.83$, $p = .1$. The interaction of reading ability and presentation condition just failed to reach significance, $F(1,38) = 3.51$, $p = .07$. However, as expected, the below average readers marked significantly fewer required breaks in the no-prosody condition than in the prosody condition, $F(1,38) = 8.95$, $p < .01$. There were no significant differences among the below average readers in the prosody condition, the above average readers in the prosody condition, or the above average readers in the no-prosody condition.

There was also a significant effect of type of structure, $F(1,152) = 14.04$, $p < .001$. The children marked required breaks more often between clauses (structures A, B, and C) than at the end of initial noun phrases (D) or between elements conjoined within phrases (E). However, this appears to be an artifact of the criterion used to select the points requiring breaks, since the adults were further above the 50% criterion for between clause boundaries than for the other types. Structure type did not interact with reading ability or presentation condition, $F < 1$ in both cases.

Discussion

Fourth grade children's performance on a parsing task was measured when prosodic information was and was not available. The total number of word groups marked did not differ for the above and below average readers, or for the no-prosody and prosody presentation conditions. Points which required word group boundaries to be marked were determined from adult norms. The below average readers in the no-prosody condition marked fewer of these required breaks than they did in the prosody condition. There were no significant differences in the number of required breaks marked by the below average readers in the prosody condition, the above average readers in the prosody condition, or the above average readers in the no-prosody condition. These results are consistent with the hypothesis that the lack of prosodic information in written language contributes to the difficulty some children have in parsing written sentences.

An alternative explanation of these results could be based on the notions of processing load and limited processing capacity (LaBerge & Samuels, 1974; West, 1978). According to this view, in order to parse written sentences children must decode the words and use the syntactic and semantic information. Both decoding and syntactic and semantic analysis require processing capacity, of which there is a limited amount available. The below average readers are presumably less skilled decoders than the above average readers. Therefore, they must expend more of their processing capacity on decoding, leaving less available for syntactic and semantic analysis. In listening, decoding is not required, so that the two groups would be equally able to allot capacity to syntactic and semantic analysis. This explanation of our results seems unlikely since we used simple vocabulary and none of the children reported any difficulty with any of the words.

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Footnotes

We are grateful to the principals, teachers, and pupils of the following Illinois schools for their cooperation in this and related research projects: Webber, Prairie, and Wiley in Urbana; White Heath in Monticello; Pleasant Acres in Rantoul; and Lincoln Trails in Mahomet. We would also like to thank Linda Baker and P. Head for their helpful comments on drafts of this paper and Robert Kantor for numerous consultations on linguistic questions. This research was supported by Contract No. US-NIE-C-76-0116 from the National Institute of Education and Grant HD 00244 from the U.S. Public Health Service.

[1]Breaks marked either before or after and, when, if, or because were counted as appropriate.

Appendix: Sample Stimuli Passage

GLODS

D
The yellow winged glod is an insect that lives on Orese.

C
Glods are very large and they are easy to see.

A E
When they are born they look just like worms and small snakes.

D
Their longs wings can move forward and backward.

A E
Because they have such long wings they can fly very fast and for a long time.

C
Glods sleep during the day and eat at night.

C
Young glods sleep under rocks and adult glods sleep in trees and bushes.

B
The adult glods will sleep in big and old houses if they can't find trees or bushes.

C
Some glods eat trees and some glods eat animals.

E
Glods will eat wild animals and animals in houses.

E
They can eat large and small trees.

E
The people on Orese know there are glods with one mouth and glods with two mouths.

D E
The glods with two mouths have one mouth for meat and one mouth for plants.

D
The adult yellow winged glod wakes up when the sun goes down.

A E
When they are hungry they will go to towns and nearby cities.

A
If they can't find food they become wild and dangerous insects.

D
Many men and women have been bitten and killed by hungry glods.

A
When people are bitten by glods they turn yellow and blue.

D B
The people on Orese get scared when they know glods are coming.

Every man and woman knows that glods can bite hard and fast.

C E
Glods are afraid of water and they stay away from rivers and large lakes.

A
If a glod gets wet his wings get heavy and slow.

D B
The people in the towns get hoses and buckets of water when the glods are coming.

B
The people can use the water to fight if the glods get too close.

D E
Some very brave people hunt for glods in trees and glods under rocks.

C
Most people just leave the glods alone and hope they will stay away.

Table 1

Mean Number of Word Groups Marked Per Sentence

	No-Prosody Condition	Prosody Condition
Below average readers	1.79	1.94
Above average readers	1.98	1.89

Table 2

Proportion of Required Breaks Marked

	No-Prosody Condition	Prosody Condition
Below average readers	.56	.69
Above average readers	.71	.76

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